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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/897,839	07/21/97	NISHIMOTO	Y

MM91/0619

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EXAMINER	
EATON, K	
ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 06/19/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No.	Applicant(s)	
	08/897,839	NISHIMOTO ET AL.	
	Examiner	Art Unit	
	Kurt M. Eaton	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 April 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *43-52* is/are pending in the application.

4a) Of the above claim(s) *49-52* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *43-48* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15)☐ Notice of References Cited (PTO-892)

16)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

17)☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *24* .

18)☐ Interview Summary (PTO-413) Paper No(s). _____ .

19)☐ Notice of Informal Patent Application (PTO-152)

20)☐ Other: .

Application/Control Number: 08/897,839
Art Unit: 2823

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of claims 43-48 in Paper No. 26 is acknowledged. The traversal is on the ground(s) that the alternative method hypothesized by the examiner for forming the semiconductor device of Group II is impractical. This is not found persuasive because, while the aforementioned alternative may or may not be impractical, the inventions of the two Groups are distinct given that it was shown that the product as claimed in the invention of Group II can be made by another and materially different process as that claimed in the invention of Group I. Arguing impracticality of an alternative method to make a device does not negate the fact that an alternative method to make a device may exist.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 49-52 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in Paper No. 26.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 46 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

5. The term "predetermined" in claim 46 is a term which renders the claim indefinite. The term "predetermined" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

6. Claim 46 recites the limitation "wherein thickness (t) of i - th insulating film..." in lines 1-2 of claim 46. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 43-45, 47, and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over applicants admitted prior art in view of Matsuura.

In re claims 43 and 44, applicants admitted prior art shows in Figure 1B forming, as a first interconnection level, a first insulating layer with a first type of stress; after forming the first insulating layer, forming a second insulating layer with a second type of stress that is different from the first type of stress; forming a conductive interconnection layer on and in contact with the second insulating layer; and repeating the aforementioned steps by forming, as a second interconnection level, a secondary first insulating layer with the first type of stress on and in contact with the conductive interconnection layer; after forming the secondary first insulating layer, forming a secondary second insulating layer with the second type of the stress that is different from the first

type of stress; and forming a secondary conductive interconnection layer on and in contact with the secondary second insulating layer, wherein the each of the conductive interconnection layers are sandwiched between and in contact with insulating layers of both types of stress. Applicants admitted prior art also discloses that cracks, due to the type of stress that the second insulating layer exhibits, may be formed in the second insulating layer {page 1, line 15 - page 5, line 13}.

Applicants admitted prior art does not show forming a third insulating layer with the first type of stress immediately prior to the formation of any of the conductive interconnection layers (or immediately after the formation of the any of the second insulating layers with the second type of stress).

Matsuura shows in Figures 5A-5B forming a first insulating layer (13) with the first type of stress over a previously formed conductive interconnection layer (12); after forming the first insulating layer, forming a second insulating layer (14) with the second type of stress that is different from the first type of stress; and immediately after the formation of the second insulating layer with the second type of stress, forming a third insulating layer with the first type of stress. Matsuura also discloses that cracks may be generated in the second insulating film with the second type of stress and further that there is the possibility of a stress-migration effect occurring in the conductive interconnection layer due to the stress effects exhibited by the second insulating layer. Accordingly, the third insulating layer with the first type of stress is formed over the second insulating film with the stress of the second type in order to relax the stress present in the structure {column 6, line 62 - column 7, line 21}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a third insulating layer with the first type of stress immediately prior to the formation of any of the conductive interconnection layers (or immediately after the formation of the any of the

second insulating layers with the second type of stress) in the invention of applicants admitted prior art as in Matsuura since, as evidenced by Matsuura in an equivalent structure such as that found in the interconnection levels of applicants admitted prior art, a third layer of insulating material with the first type of stress would relax the stress present in the structure and reduce the deleterious effects of stress-migration in the conductive interconnects. Accordingly, it would have been obvious that, upon forming the third insulating layer as described above, that the conductive interconnection layers of applicants admitted prior art in view of Matsuura within the various interconnect levels would have been in contact with the first and third insulating layers with the stress of the first type such that the conductive interconnection layers would have been sandwiched between and in contact with the first insulating layer and the third insulating layer so as to suppress bending of the interconnection layer.

In re claim 45, both applicants admitted prior art and Matsuura show wherein the first type of stress is compressive stress and wherein the second type of stress is tensile stress {see applicants admitted prior art at page 1, line 15 - page 5, line 13 and Matsuura at column 6, line 62 - column 7, line 21}.

In re claim 47, applicants admitted prior art shows wherein the forming of the first insulating film with the first type of stress is by plasma CVD {page 1, line 15 - page 5, line 13}.

Applicants admitted prior art fails to show wherein the forming of the third insulating film with the first type of stress is by heating for reaction a gaseous mixture including at least an organic silane and oxygen.

Matsuura shows wherein the third insulating film with the first type of stress is by heating for reaction a gaseous mixture including at least an organic silane and oxygen {column 6, line 62 - column 7, line 21}.

In re claim 48, applicants admitted prior art substantially discloses the invention as claimed but fails to show wherein the conductive interconnection layer is made of aluminum.

Matsuura shows wherein conductive interconnection layers may be made of aluminum {column 4, lines 57-61}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the conductive interconnection layers of applicants admitted prior art in view of Matsuura out of aluminum since, as evidenced by Matsuura, aluminum is a well known material which can be formed into a conductive interconnection layer. and the selection of a known material on the basis of its suitability for the intended use involves only routine skill in the art.

9. Claim 46 is rejected under 35 U.S.C. 103(a) as being unpatentable over applicants admitted prior art in view of Matsuura as applied to claim 43 above, and further in view of Harriott.

In re claim 46, applicants admitted prior art in view of Matsuura substantially discloses the invention as claimed but fails to show wherein a thickness (t_i) of the i-th insulating film of the stress adjusted film is determined so as not to exceed a predetermined stress (σ_i) of the overall stress adjusted insulating film where the stress (σ_i) is calculated as: $(\sigma_i) = \Sigma_{I=1}^{n} t_i \times \sigma_i$, wherein σ_I is stress in the i-th insulating film and is positive when tensile stress and negative when compressive stress.

Harriott teaches wherein a laminated insulating film made of individual laminae stressed in either tension or compression can be made to exhibit a compressive stress. Harriott also shows that the thicknesses of the individual insulating layers in the laminate contributes in affecting the overall stress in the laminate {column 3, lines 11-13 and 25-30}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the compressive stressed and tension stressed insulating layers of applicants admitted

prior art in view of Matsuura such that they had an overall stress in compression as suggested by Harriott in order to avoid problems associated with delamination and to ensure a reliable device.

Applicants admitted prior art in view of Matsuura and Harriott still does not show wherein the overall stress (σ_o) is calculated as: $(\sigma_o) = \Sigma_{i=1}^{n} t_i \times \sigma_i$, wherein σ_i is stress in the i-th insulating film and is positive when tensile stress and negative when compressive stress.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to characterize the overall stress in the laminate in applicants admitted prior art in view of its modifiers according to the aforementioned equation since the aforementioned equation is a well known equation used to describe the stress exhibited in a laminated film based solely on the stress and thickness of its constituents.

Response to Arguments

10. Applicant's arguments with respect to claims 43-48 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

11. Paper related to this application may be submitted directly to Art Unit 2823 by facsimile transmission. Papers should be faxed to Art Unit 2823 via the Art Unit 2823 Fax Center located in Crystal Plaza 4, room 4C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2823 Fax Center number is **(703) 308-7722** or **-7724**. The Art Unit 2823 Fax Center is to be used only for papers related to Art Unit 2823 applications.

Any inquiry concerning this communication of earlier communication from the examiner should be directed to **Kurt Eaton** at **(703) 305-0383** and between the hours of 8:00 AM to 4:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via kurt.eaton@uspto.gov.

LONG PHAM
PRIMARY EXAMINER